SIEMENS

ARCADIS Avantic

SP

Adjustment

System

Main System / Adjustment

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Tools, Test Equipment and Aids

NOTE

All tools, test equipment and aids with the exception of those marked "*", are listed along with their specifications in the STC (Service Tools Catalogue).

- Standard tool kit *****
- Multimeter Digital
  e.g. "Fluke 8060 A" — Part no. 97 02 101 Y4290
- Oscilloscope > 50 MHz
  e.g., Fluke CombiScope PM 3390 A — Part no. 99 00 861 Y3155
- Dose measurement device
  e.g., PTW-DALI ***** — no longer in ARTD
  e. g., PTW-NOMEX ***** — no longer in ARTD
  e.g., PTW-DIADOS — Part no. 97 17 612 Y0388
- Protective conductor meter
  e.g., Unimed 1000 tester — Part no. 51 38 727 Y0766
- 1 set of radiation filters — e.g., Part no. 97 98 596 G5321
- Centering cross — e.g., Part no. 96 60 051 RE999
- Torque wrench 10 - 80 Ncm (necessary for image rotation adjustment) — Part no. 080 79 241

Safety Information and Safety Measures

NOTE

When performing service work and tests, please observe:

- the product-specific information in the document "Replacement of Parts", SPR2-330.841.01.

- the safety information in TD00-000.860.01.. in the register in the ARCADIS binder, as well as

- the safety information contained in the ARTD, Part 2.

⚠WARNING

Dangerous X-ray radiation during checks and adjustment work steps.

Risk of death or serious physical injury.

➪ **For checks and adjustments that must be performed with radiation switched on, the prescribed radiation safety measures must be observed; if necessary, wear radiation protective clothing (see also ARTD-002.731.02...and ARTD-002.731.38... "General Guidelines for Technical Service"). These checks and adjustments are explicitly labeled on the following pages with the radiation warning symbol** **.**

Symbols

This symbol means "X-ray", checks, and adjustments that must be performed with radiation ON.

This symbol means "Torque Value", note regarding a threaded connector.

General Information for the following Adjustments

1. Switch on the ARCADIS System.
2. In the application menu bar, click on <Options>-<Service>-<Local Service>.
3. Enter the (6 digits) password.
4. Click on <**OK**>.
5. Click on <**Main System**>.
6. Select - "ARCADIS Avantic - 33 cm (13 inch) Image Intensifier"
7. Click on <**Next**>.

The following adjustments are available:

- Generator Adjustment
- Generator Adjustment Check
- Load Counter
- Image Rotation
- Collimator X-iris
- Display X-iris
- Collimator Slot Diaphragm
- Display Slot Diaphragm
- Dose Area Product
- Air Kerma
- Dose Rate Adjustment / Checking the Dose Rate in Automatic Mode

These adjustments are described on the following pages in the above-mentioned sequence in this document, and they are also available in the system. A <**click here**> link is available on the pages where adjustments are possible. Click on <**click here**>; the relevant adjustment description page will come up on the monitor. Always place the description page on the right monitor.

NOTE

After making changes under "Configuration" or "Adjustment", a backup of the new values is required.

NOTE

After entering the service menu, the currently selected dominant is shown as a circle in the radiation field.

Abbreviations

DAP	Dose area product
DAP int	Dose area product, internal measurement from system
DAP ext	Dose area product, external measurement from dose meter
K_a int	Dose (Air Kerma), internal measurement from system
K_a ext	Dose (Air Kerma), external measurement from dose meter
$\Delta K_a/\Delta t$ int	Dose rate (Air Kerma), internal measurement from system
$\Delta K_a/\Delta t$ ext	Dose rate (Air Kerma), external measurement from dose meter
CFC	Continuous fluoroscopy
PFC	Pulsed fluoroscopy

Generator Adjustment

1. Register an emergency patient to allow radiation release.
2. Place 2.1 mm Cu on the radiation exit port of the single tank.
3. Click on <**Go**>.
   - ➪ Action bar: “start fluoroscopy”

4. **Start fluoro**.
   - ➪ Action bar: “continue fluoro”
   - ➪ Status bar: “kV- offset-learning”
   - ➪ Status bar: “warmup” (~ 12 minutes)
   - ➪ Status bar: “filament correction”
   - ➪ Status bar: “learning .....”
   - ➪ Status bar: “learning done”
5. **Stop fluoro**.
6. Click on <**Save**>.
   - ➪ A window appears: “Main system values were successfully saved” --> confirm with <**OK**>.
7. Click on “**>**” for the next page (Generator Adjustment Check) and perform a generator adjustment check.

Generator Adjustment Check

1. **Create a new exam set:**

   In the menu bar click on <Options>-<Configuration...>-<Examination Set Configuration>-<Ortho/Trauma>-<“Body Region Leg”>-<Examination Set Standard>-<Copy As...>.

   Enter “Service” for the “New Exam Set Name” and click on <OK>.

2. **Modify the exam set “Service”:**

   Click on the new exam set <Service>-<Edit...>-<Digital Radiography>.

   Select “Noise Reduction” = **1**, click on <Apply>-<OK>-<OK> and close the window.

3. Under the task card “Examination” select “Ortho/Trauma”-“Body Region Leg” and the newly-created exam set “Service”.
4. Select the “Digital Radiography” operating mode.
5. Press the kV Stop key on the main system control console.
6. Set **62 kV** ± 1 and **200 mA** ± 20 with the kV+ / kV- keys on the main system control console.

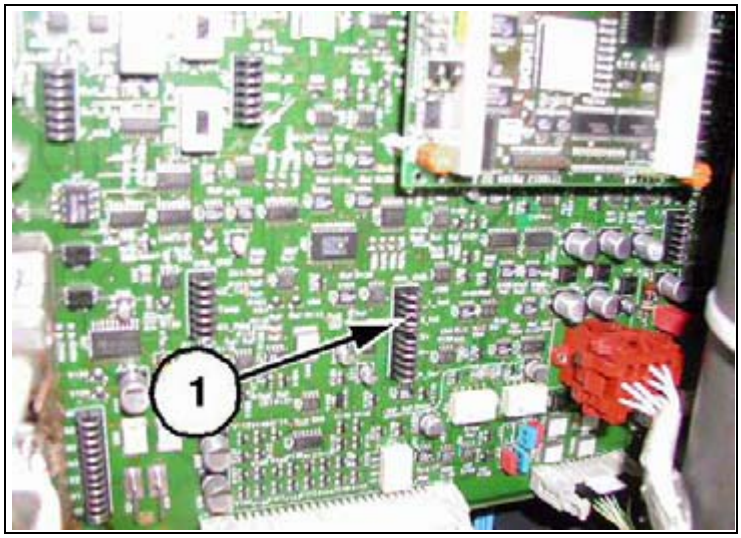

Fig. 1: Measuring points

7. Connect oscilloscope channel 1 to the test point (1/Fig. 1 / p. 9) D21 “kV_Ist”. Ground: D21 “ANA_GND”.
8. Connect oscilloscope channel 2 to the test point (1/Fig. 1 / p. 9) D21 “I_T_Ist”. Ground: D21 “ANA_GND”.

   ➪ set the trigger level to 2.24V for kV_Ist (equal to 75% of max. kV_Ist)

9. Release an exposure with the hand switch and store the oscillogram.
10. Evaluate the oscillogram(Fig. 2 / p. 10), tolerances for the mA curve:

    ➪ 5 ms after pulse start to 5 ms before pulse end: ± 20%

    ➪ during the last 5 ms before pulse end: ± 10%

11. If the tube current (Fig. 2 / p. 10) exceeds the specified tolerances, the generator adjustment and the mAs counter adjustment must be repeated.

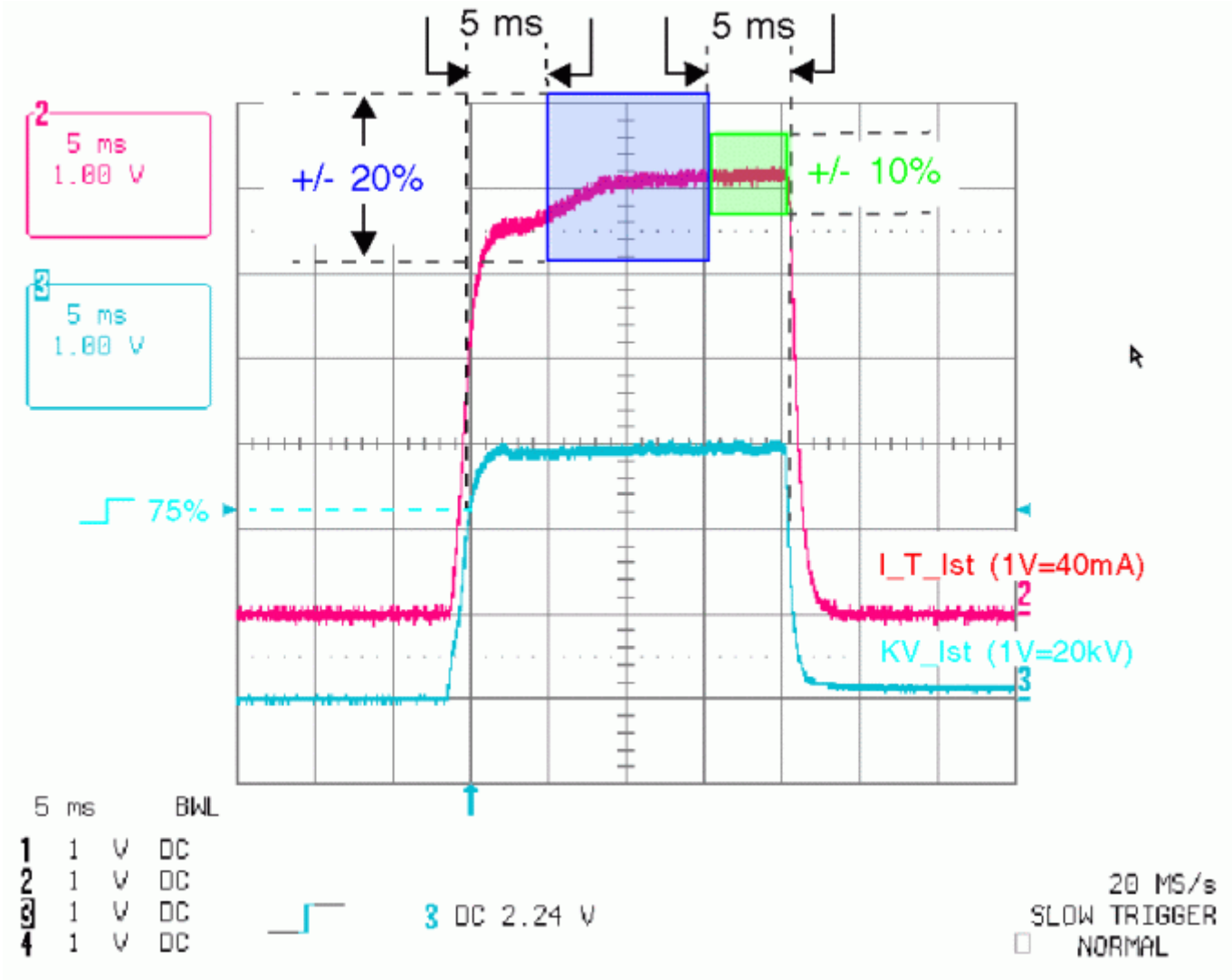
5 ms
5 ms
2
5 ms
1.00 V
3
5 ms
1.00 V
+/- 20%
+/- 10%
75%
I_T_Ist (1V=40mA)
KV_Ist (1V=20kV)
5 ms BWL
1 1 V DC
2 1 V DC
3 1 V DC
4 1 V DC
3 DC 2.24 V
20 MS/s
SLOW TRIGGER
NORMAL

Fig. 2: kV_mA

Load Counter

Store load counter data

1. Switch on the system and insert a CD into the CD-ROM drive.
2. Open the service application.
3. Click on <Reports> and <Configuration Online>.
   ➪ A new report of the main system will be generated.
4. Click on <Exit> to close this window.
5. Click on <Eventlog> and <Burn Log-Files> in the service menu.
   ➪ The window “Do you want to burn a newly created developer SaveLog too?” appears.
6. Click on <Yes> , <Select All> and <Burn Files>.
   ➪ All data will be burned to CD, including the actual load counter data and the event log.

NOTE

A replacement of the D1 board (main system) sets the “Reset counter” and the load units to “0”.

Load Counter Reset

1. Install the new tube and enter the new single tank serial number under <Main System>-<Configuration>-<Load Counter>.
2. Under “Adjustment” click on <Load Counter>.
3. Click on <**Go**> to reset the load counter.
   ➪ A load counter reset is only possible after the new single tank serial number is entered under <Main System>-<Configuration>-<Load Counter>.
4. Click on <**Go**> to end the reset of the load counter.
   ➪ The main system reboots.
   ➪ The error message “Single tank is not equal...” appears.

NOTE

After a load counter reset, the actual serial number of the new tube is not shown under <Main System>-<Adjustment>-<Load Counter> until a “Generator Adjustment” has been performed.

5. Under “Adjustment” click on <Generator Adjustment> and perform a “Generator Adjustment”
6. After the “Generator Adjustment” , check whether the “Load Counter” reset has been carried out.
   ➪ Check under <Main System>-<Adjustment>-<Load Counter> whether the “single tank serial number” has changed to the new tube serial number.

NOTE

For warranty reasons send the burned CD together with the single tank and the tube questionnaire back to the factory.

Image Rotation

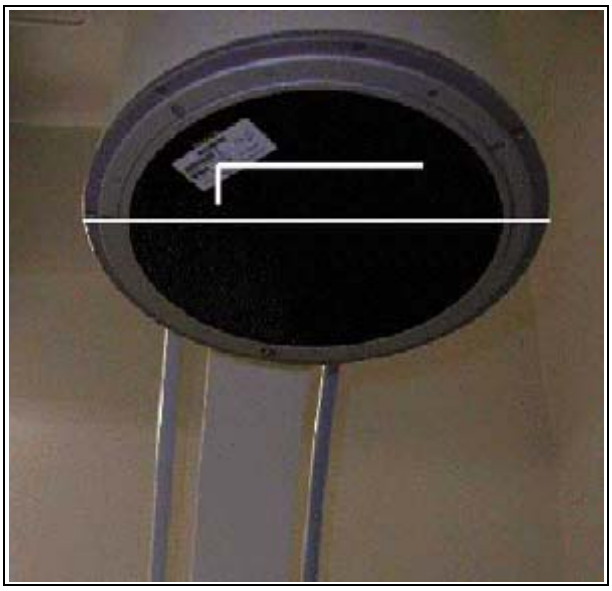

Fig. 3: I.I._input

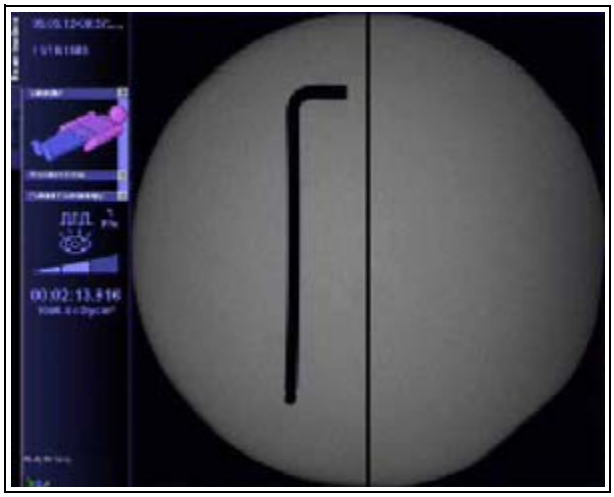

Fig. 4: Image_position

Adjustment

1. Register an emergency patient to allow radiation release.
2. Manually set the image rotation to the 0 degree position at the control console.
   ➪ See the display for image rotation at the control console.
3. Attach an Allen key and a solder wire to the image intensifier as shown in (Fig. 3 / p. 12).
4. Briefly release fluoro.
   ➪ The image (left/right/up/down) should correspond to (Fig. 4 / p. 12).

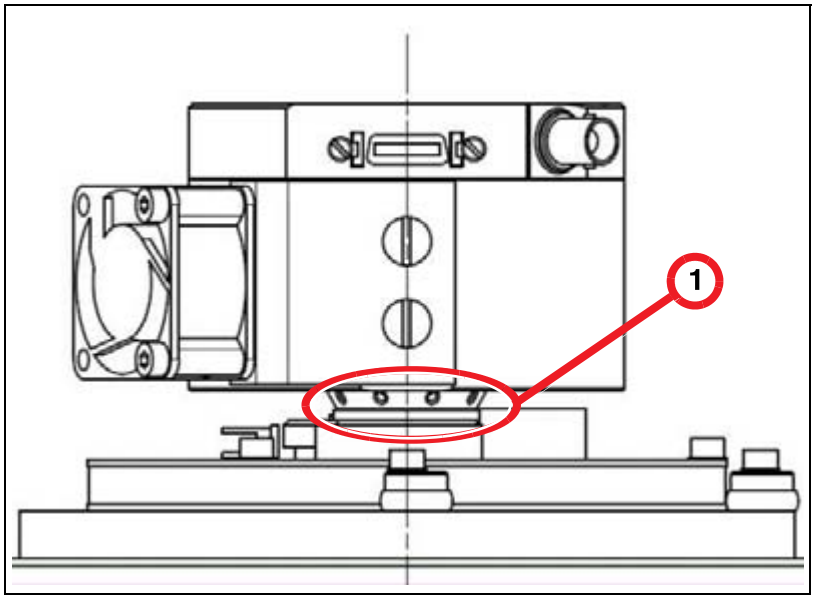

Fig. 5: Image _rotation

5. If the 0 degree position is not correct, remove the I.I. cover, remove the 3 M2 Allen screws (1/Fig. 5 / p. 12) from the camera flange, manually rotate the camera to the correct position, then reinsert and retighten the 3 M2 Allen screws.

   ➪ Tightening torque: 14 ± 1 Ncm

6. Briefly release fluoro.

   ➪ The image should now shown in the correct 0 degree position (Fig. 4 / p. 12), if not, repeat the adjustment.

Collimator X-iris

Prerequisites

- Use the X-iris keys on the control console for the adjustment.
  - ➪ At least 2 blades of the X-iris must be visible.
  - ➪ For countries with DHHS regulation, 8 blades must be visible.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Attach the centering cross in the center of the image intensifier input screen.
3. To deselect the circle mask, select "**Transparent**" and click on <**Activate**>.
4. Click on <**Go**>.
   - ➪ Status bar: Init (LimitsOff/Autosearch) --> running --> success

II. - Full Format Position

5. Release fluoro and adjust the X-iris so that the blades are still visible along the edge of the I.I.

NOTE

For units with Air Kerma display, a default value of 295 mm for "X-iris I.I.-Full Format Position" is used for software calculation. Enter different diameter settings under <Configuration>-<Main System>-<Air Kerma> "X-Iris Open Position in mm".

6. Stop fluoro and click on <**Go**>.
   - ➪ Status bar: I.I. - Full Format Position --> running --> success

II. - Zoom 1 Position

7. Release fluoro and adjust the X-iris so that the blades are still visible along the edge of the I.I.
8. Stop fluoro and click on <**Go**>.
   - ➪ Status bar: II. - Zoom 1 Position --> running --> success

II. - Zoom 2 Position

9. Release fluoro and adjust the X-iris so that the blades are still visible along the edge of the I.I.
10. Stop fluoro and click on <**Go**>.
    - ➪ Status bar: II. - Zoom 2 Position --> running --> success

II. - Zoom 3 Position

11. Release fluoro and adjust the X-iris so that the blades are still visible along the edge of the I.I.
12. Stop fluoro and click on <**Go**>.
    - ➪ Status bar: II. - Zoom 3 Position --> running --> success

Closed Position

13. Release fluoro and close the X-iris until the X-ray field is 43 mm. Tolerance: + 2 mm / - 3 mm.
    - ➪ See attached centering cross.

NOTE

For units with Air Kerma display, it is important for software calculation for the X-iris closed position to be adjusted accurately.

14. Stop fluoro and click on <**Go**>.
    - ➪ Status bar: Closed Position --> running --> success

Init Off & Store Positions

15. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Positions --> running --> success
    - ➪ A window appears: “Calibration is finished...” --> confirm with <**OK**>.
    - ➪ The main system restarts.
16. Click on “**>**” for the next page.
    - ➪ The main system restarts and the circle mask switches back to on.
    - ➪ The X-iris positions can be configured manually here.
17. Configure the “Zoom Procedure” on this page per the country regulations or the customer’s preference.
18. Click on “**>**” and “**>**” for the next pages and click on <**Finish**>.
19. Check the adjustment and repeat if necessary.

Display X-iris

Prerequisites

- Use the X-iris keys on the control console for the adjustment.
- “Collimator X-Iris” has been adjusted correctly.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Click on <**Go**>.
   ➪ Status bar: Init --> running --> success

Open Pos. II. - Full Format

3. Briefly release fluoro for the LIH image.
4. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
5. Click on <**Go**>.
   ➪ Status bar: Open Pos. II. - Full Format --> running --> success

Close Pos. II. - Full Format

6. Briefly release fluoro for the LIH image.
7. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
8. Click on <**Go**>.
   ➪ Status bar: Close Pos. II. - Full Format --> running --> success

Close Pos. II. - Zoom 1

9. Briefly release fluoro for the LIH image.
10. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
11. Click on <**Go**>.
    ➪ Status bar: Close Pos. II. - Zoom 1 --> running --> success

Close Pos. II. - Zoom 2

12. Briefly release fluoro for the LIH image
13. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
14. Click on <**Go**>.
    ➪ Status bar: Close Pos. II. - Zoom 2 --> running --> success

Close Pos. II. - Zoom 3

15. Briefly release fluoro for the LIH image.
16. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
17. Click on <**Go**>.
    - ➪ Status bar: Close Pos-. II. - Zoom 3 --> running --> success

Open Pos. II. - Zoom 3

18. Briefly release fluoro for the LIH image.
19. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
20. Click on <**Go**>.
    - ➪ Status bar: Open Pos-. II. - Zoom 3 --> running --> success

Open Pos. II. - Zoom 2

21. Briefly release fluoro for the LIH image.
22. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
23. Click on <**Go**>.
    - ➪ Status bar: Open Pos-. II. - Zoom 2 --> running --> success

Open Pos. II. - Zoom 1

24. Briefly release fluoro for the LIH image.
25. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
26. Click on <**Go**>.
    - ➪ Status bar: Open Pos-. II. - Zoom 1--> running --> success

Init Off & Store Values

27. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Values --> running --> success
    - ➪ A window appears: “Calibration is finished...” --> confirm with <**OK**>.
    - ➪ The main system restarts
28. Click on “**>**” for the next page and click on <**Finish**>.
29. Check the adjustment and repeat if necessary.

Collimator Slot Diaphragm

Prerequisites

- Image rotation has been adjusted correctly.
- Use the slot diaphragm keys on the control console for the adjustment.
- Image reversal functions are disabled.
- Use 2.1 mm Cu as the prefilter.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Click on <**Go**>.
   ➪ Status bar: Init (LimitsOff/Autosearch) --> running --> success

0 Degree Position

3. Release fluoro and move the slot diaphragm to the horizontal position (→) on the monitor.
4. Stop fluoro and click on <**Go**>.
   ➪ Status bar: 0 Degree Position --> running --> success

II. - Full Format Position

5. Release fluoro and open the slot diaphragm so that the blades begin to disappear at the edge of the image.

NOTE

For units with Air Kerma display, it is important for software calculation for the slot diaphragm in "II.- Full Format Position" to be adjusted accurately to the edge of the visible I.I. field.

6. Stop fluoro and click on <**Go**>.
   ➪ Status bar: II. - Full Format Position --> running --> success

II. - Zoom 1 Position

7. Release fluoro and open the slot diaphragm so that the blades begin to disappear at the edge of the image.
8. Stop fluoro and click on <**Go**>.
   ➪ Status bar: II. - Zoom 1 Position --> running --> success

II. - Zoom 2 Position

9. Release fluoro and open the slot diaphragm so that the blades begin to disappear at the edge of the image.

10. Stop fluoro and click on <**Go**>.
    - ➪ Status bar: II. - Zoom 2 Position --> running --> success

II. - Zoom 3 Position

11. Release fluoro and open the slot diaphragm so that the blades begin to disappear at the edge of the image.
12. Click on <**Go**>.
    - ➪ Status bar: II. - Zoom 3 Position --> running --> success

Init Off & Store Positions

13. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Positions --> running --> success
    - ➪ A window appears: “Calibration is finished...” --> confirm with <**OK**>.
    - ➪ The main system restarts.
14. Click on “**>**” and “**>**” for the following pages and click on <**Finish**>.
15. Check the adjustment and repeat if necessary.

Display Slot Diaphragm

Prerequisites

- “Collimator Slot Diaphragm” has been adjusted correctly.
- Use the slot diaphragm keys on the control console for the adjustment.
- Use 2.1 mm Cu as the prefilter.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Click on <**Go**>.
   ➪ Status bar: Init --> running --> success
   ➪ Press the collimator X-iris “open button” on the control console to open the X-iris completely.

Right/Open Pos. II. - Full Format

3. Press the collimator X-iris “open button” on the control console to open the X-iris completely.

4. Briefly release fluoro for the LIH image.
5. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
6. Click on <**Go**>.
   ➪ Status bar: Right/Open Pos. II.-Full Format --> running --> success

Right/Close Pos. II. - Full Format

7. Briefly release fluoro for the LIH image.
8. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
9. Click on <**Go**>.
   ➪ Status bar: Right/Close Pos. II.-Full Format --> running --> success

Left/Close Pos. II. - Full Format

10. Briefly release fluoro for the LIH image.
11. Adjust the display line on the monitor until the line is aligned with the front edge of the left-hand side slot diaphragm blade.
12. Click on <**Go**>.
    ➪ Status bar: Left/Close Pos. II.-Full Format --> running --> success

Right/Close Pos. II. - Zoom 1

13. Briefly release fluoro for the LIH image.
14. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
15. Click on <**Go**>.
    ➪ Status bar: Right/Close Pos. II.-Zoom 1 --> running --> success

Right/Close Pos. II. - Zoom 2

16. Briefly release fluoro for the LIH image.
17. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
18. Click on <**Go**>.
    ➪ Status bar: Right/Close Pos. II.-Zoom 2 --> running --> success

Right/Close Pos. II. - Zoom 3

19. Briefly release fluoro for the LIH image.
20. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
21. Click on <**Go**>.
    ➪ Status bar: Left/Close Pos. II.-Zoom 3 --> running --> success

Right/Open Pos II. - Zoom 3

22. Briefly release fluoro for the LIH image.
23. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
24. Click on <**Go**>.
    ➪ Status bar: Right/Open Pos. II.-Zoom 3 --> running --> success

Right/Open Pos. II. - Zoom 2

25. Briefly release fluoro for the LIH image.
26. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.
27. Click on <**Go**>.
    ➪ Status bar: Right/Open Pos. II.-Zoom 2 --> running --> success

Right/Open Pos. II. - Zoom 1

28. Briefly release fluoro for the LIH image.
29. Adjust the display line on the monitor until the line is aligned with the front edge of the right-hand side slot diaphragm blade.

30. Click on <**Go**>.
    - ➪ Status bar: Right/Open Pos. II.-Zoom 1 --> running --> success

Init Off & Store Values

31. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Values--> running --> success
    - ➪ A window appears: “Calibration is finished...” --> confirm with <**OK**>.
    - ➪ The main system restarts.
32. Click on “**>**” for the next page and click on <**Finish**>.
33. Check the adjustment and repeat if necessary.

Dose Area Product

NOTE

A chamber gain adjustment is necessary if the DAP accuracy check or the Air Kerma accuracy check is not in tolerance.

Wellhöfer - chamber gain adjustment

1. Register an emergency patient to allow radiation release.
2. Select the dose rate for Air Kerma or the dose for DAP, depending on the configuration, at the external dose meter.

NOTE

Ensure that 2.5 mm AL filtration is selected at the external dose meter during the chamber gain adjustment.

3. Attach the small dose measurement chamber (1 cm^3) to the center of the I.I. grid.
4. Select I.I. full format and open the collimator X-iris and the slot diaphragm to the maximum position.
5. Select the following exam set to obtain the HC2 control curve:
   - ➪ Ortho/Trauma; Standard; Body reg = HIP; Fluoroscopy

6. Briefly release fluoro, select the <kV STOP> key and 70 kV with the kV +/- buttons on the console.

7. Release fluoro and compare the dose rate from the external dose meter to the internal monitor display.
   - ➪ Use the correction factors and calculations described under “DAP accuracy check” or under “Air Kerma accuracy check”.
   - ➪ Calculate the deviation of the external dose meter from the internal monitor display. **Difference = [(int. value) - (ext value)] / (ext value)**
   - ➪ The maximum allowed difference is **± 0.25** (± 25%).
8. Remove the cover from the single tank.

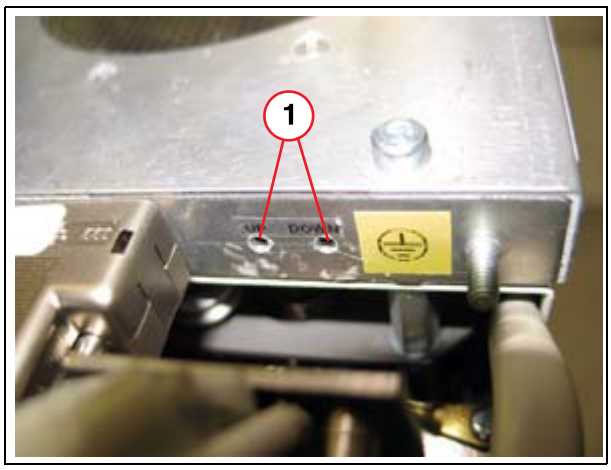

Fig. 6: Wellhöfer_DAP

9. Adjust the chamber gain by pushing the up or down button for at least 200 ms for each push at the chamber (1/Fig. 6 / p. 23).
   - ➪ Use a small Allen key (diameter 0.5-1.0 mm) to push the “UP” or "DOWN” button (e.g. 20 x push down = -10%).
   - ➪ “DOWN” = 0.5% reduction in gain per 200 ms push.
   - ➪ “UP” = 0.5% increase in gain per 200 ms push.
10. Reinstall the single tank cover and perform a “Wellhöfer chamber test”.

NOTE **A “Wellhöfer chamber test” is necessary after a “Wellhöfer chamber gain adjustment”.**

Wellhöfer chamber test

1. Click on <**Go**> to start the chamber test.
   - ➪ Status bar: success
   - ➪ Wait about 3 seconds for the constant readout.
2. Note the displayed “DAP” or “Air Kerma” from the ARCADIS monitor depending on the configuration (path: <Configuration>-<Imaging System>-<Display Settings>).
   - ➪ With “DAP” configured, the monitor indication is ”xx.xx cGcm^2”.
   - ➪ With “Air Kerma” configured, the monitor indication is “xxxx.x mGy“.
3. Click on <**Go**> again to stop the chamber test.
   - ➪ Status bar: success
   - ➪ The following window appears: Calibration is finished --> confirm with <**OK**>.
   - ➪ The main system restarts.
4. Enter the chamber constant from the monitor acquisition task card under <Main System>-<Configuration>-<Option> “DAP chamber resolution”.
   - ➪ With “DAP” display: Multiply the monitor value by 100 and enter the 4 digits (e. g. 49.97 x 100 = 4997).
   - ➪ With “Air Kerma” display: Enter the first 4 digits from the monitor value. (e.g. 4997.2 = 4997).
5. Click on <**Finish**>.
6. Continue with “DAP accuracy check”.

DAP accuracy check

Prerequisites

1. Register an emergency patient to allow radiation release.

NOTE

The "DAP accuracy check" is only possible if the "Dose Area Product" is configured under <Configuration>-<Imaging System>-<Display Settings>.

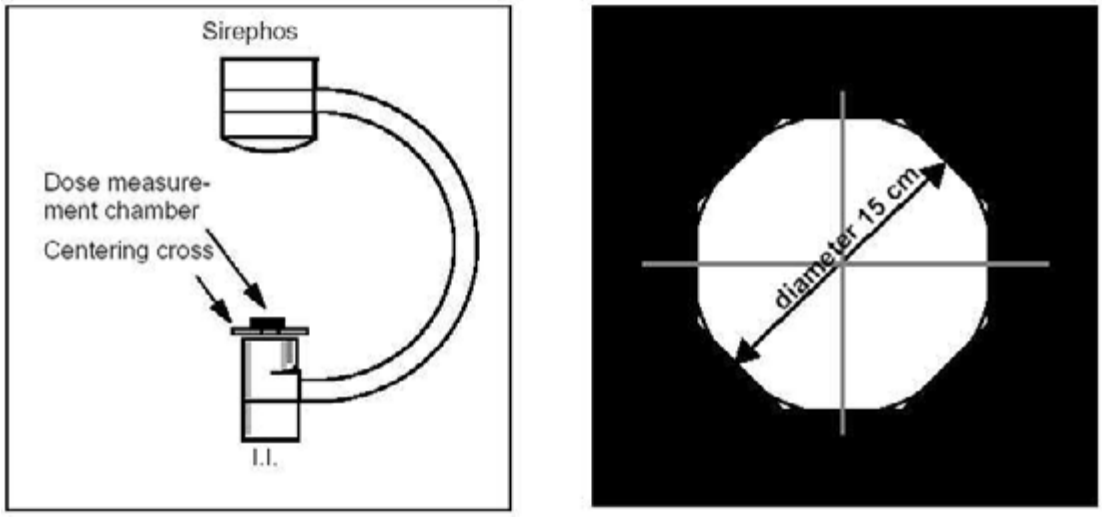

Fig. 7: Accuracy of the Dose Area Product

2. Attach and center the centering cross on the I.I. (Fig. 7 / p. 25).
3. Briefly release fluoroscopy and adjust the collimator X-iris on the X-ray field to a diameter of approx. 15 cm (Fig. 7 / p. 25).
4. Record the diameter of the octagonal area of the radiation field and remove the centering cross.
5. Attach the small dose measurement chamber (1 cm^3) to the center of the I.I.

NOTE

Ensure that the dose meter is adjusted for about 2.5 mm AL filtration during the "DAP accuracy check".

Accuracy check

1. Briefly release fluoroscopy, select the <kV STOP> key, and enter 70 kV at the control console.
2. Note the measured DAP on the ARCADIS monitor as **# 1** and set the external dose meter to "0".
3. Release fluoroscopy until a measured dose (**K_a ext**) of 4-5 mGy is displayed at the external dose meter and note this value.
4. Note the area dose product (in $cGycm^2$) displayed on the ARCADIS monitor as **# 2** and subtract **# 1** from **# 2** to get the dose (**DAP int**) to be compared to the external dose meter.
5. Use the measured dose (**K_a ext**) to calculate the comparable dose area product (**DAP ext**) in $cGycm^2$:

   ➪ **DAP ext =** (**K_a ext** in mGy) x (**diameter ^{2}** in cm) x (**0.829**) **/ 10**

NOTE

0.829 is the area calculation factor for the octagon.

6. Calculate the difference between the measured and displayed dose area product:
   ➪ **Difference = [(DAP int) - (DAP ext)] / (DAP ext)**
7. The maximum allowed difference is **± 0.25** (± 25%).
   ➪ For differences > +0.25 and < -0.25, perform the “Wellhöfer chamber gain adjustment”.

Air Kerma

NOTE

The "Air Kerma accuracy check" is only possible if the resolution 0.01 cGy cm*cm/Pulse is configured under <Main System>-<Configuration>-<Options>-<Resolution> and "Air Kerma" is configured under <Configuration>-<Imaging System>-<Display Settings>.

Prerequisites

1. Register an emergency patient to allow radiation release.
2. Select the dose rate at the external dose meter and attach the small dose measurement chamber (1 cm^3) to the center of the I.I. grid.

NOTE

Ensure that 2.5 mm AL filtration is selected at the external dose meter during the "Air Kerma accuracy check".

3. Select I.I. full format and open the collimator X-iris and the slot diaphragm to the maximum position.
4. Select the following exam set to obtain the HC2 control curve:
   - ➪ Ortho/Trauma; Standard; Body reg = HIP; Fluoroscopy
5. Read out the reference location factor (RL) under <Main System>-<Adjustment>-<DAP/Air Kerma>.
   - ➪ RL = **681** (300 mm to I.I.) --> Factory default
   - ➪ RL = **525** (150 mm to isocenter) --> Use only upon request from the customer
6. SID = 1000 mm
   - ➪ SID to the grid surface: 1000 mm - 19mm = **981** mm

NOTE

The correction factor Cx is required because the measurement chamber is attached to the grid instead of "300 mm to I.I." or "150 mm to isocenter".

7. Calculate the correction factor (Cx): **$Cx = (980/RL)^2$**
   - ➪ Cx with RL "681" = **2.08**
   - ➪ Cx with RL "525" = **3.49**

Accuracy check

1. Briefly release fluoro, select the <kV STOP> key and 70 kV with the kV +/- buttons on the console.

2. Release fluoroscopy and after approx. 10 seconds fluoro note the dose rate from the dose meter as "**$\Delta K_a/\Delta t$ ext**" and the dose rate displayed on the monitor as "**$\Delta K_a/\Delta t$ int**" and stop fluoro.

3. Calculate the difference between the dose rate and the external dose meter multiplied by Cx and the internal dose rate displayed on the monitor and converted to µGy/s:
   - ➪ Step 1: Convert monitor value ($\Delta K_a/\Delta t$) int from (mGy/min) to (µGy/s): (Δ**K$_a$/Δt int** in mGy/min) **x** (**16.66**) = (Δ**K$_a$/Δt int** in µGy/s)
   - ➪ Step 2: Multiply the external dose rate ($\Delta K_a/\Delta t$ ext) by factor (Cx): (Δ**K$_a$/Δt ext) x** (**Cx**) = (Δ**K$_a$/Δt ext _Cx**)
   - ➪ Step 3: Calculate the difference between ($\Delta K_a/\Delta t$ int) and ($\Delta K_a/\Delta t$ ext _Cx): Difference = **[(ΔK$_a$/Δt int) -** (Δ**K$_a$/Δt ext _Cx)] /** (Δ**K$_a$/Δt ext _Cx**)
4. Evaluate the measurement. The maximum allowed difference is **± 0.35** (± 35%).
   - ➪ For differences > + 0.35 and < - 0.35, an “Air Kerma dose matching” adjustment is necessary.
5. Release the kV-stop key.
6. Repeat the “Air Kerma accuracy check” two times in full format with the following conditions:
   - ➪ **1**. Slot diaphragm = maximum open.
     X-iris opening = approx. 16 cm (measured on the monitor).
   - ➪ **2**. X-iris = maximum open.
     Slot diaphragm opening diameter = approx. 16 cm (measured on the monitor).

Air Kerma dose matching

1. Attach and center the centering cross on the I.I.

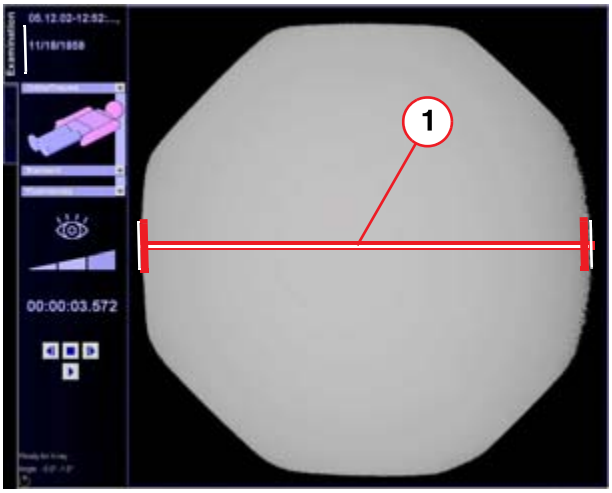

Fig. 8: diameter_x iris

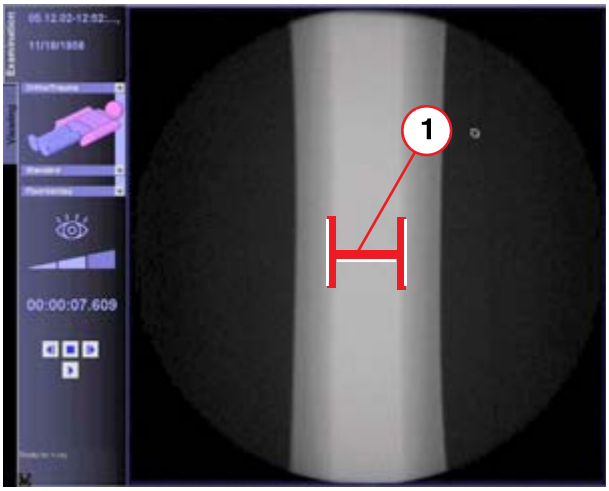

Fig. 9: diamentor_slot_diaph

2. Briefly release fluoro and measure the maximum and minimum diameter of the visible X-ray field in full format (1/Fig. 8 / p. 28).
   - ➪ Open the X-iris to the maximum position in full format and note the diameter from the centering cross.
   - ➪ Close the X-iris to the minimum position in full format and note the diameter from the centering cross.

3. Perform the collimator slot diaphragm adjustment under <Main System>-Adjustments>-<Collimator slot diaphragm>.
   - ➪ Make sure that the front edge of the slot diaphragm is accurately adjusted to the edge of the I. I. .
4. Briefly release fluoro and measure the minimum distance between the front edges of the slot diaphragm in full format (1/Fig. 9 / p. 28).
   - ➪ Use 2.1mm Cu as the prefilter to make the front edges visible.
   - ➪ Close the slot diaphragm to the minimum position in full format and note the diameter from the centering cross (front edge to front edge).
5. Insert the previously noted “open” and “closed” X-iris values and the “closed” slot diaphragm value under <Main System>-<Adjustment>-<Air Kerma> and click on <Save>.
   - ➪ X-Iris Open Pos. in mm
   - ➪ X-Iris Close Pos. in mm
   - ➪ Slot diaphragm Close Pos. in mm (1/Fig. 9 / p. 28).
   - ➪ Slot diaphragm Open Pos. = remains at the default value
6. Remove the centering cross and repeat the “Air Kerma accuracy check”.

NOTE

If the “Air Kerma dose matching” was not successful, perform the “Wellhöfer chamber gain adjustment” and the “Wellhöfer chamber test”. Then repeat the Air Kerma accuracy check.

Dose Rate Adjustment

Explanation of the status bar during the "Dose Rate Adjustment".

Auto Regulation	Indicates the current status of the automatic adjustment. (BUSY - limit search / START fluoroscopy / STOP fluoroscopy / MATCH doserate / autoadjust TV Iris / Done)
Brightness Deviation	Shows the difference in the actual brightness value minus the nominal brightness value. The brightness deviation is shown at the image rotation angle display of the control console . Tolerance = ± 10. **Note:** The "Brightness Deviation" status bar in the service window is not used and always shows "0".
Control Curve	Shows the currently selected fluoro curve. **DA CFC 75 kV** is used for dose rate adjustment.
Adjustment	Shows the operating control mode. (Generator / Camera Iris / Stop)
I.I. Zoom Status	Shows the current I.I. format (Zoom off / Zoom 1 / Zoom 2 / Zoom 3)
Doserate	Shows the dose rate during the adjustment for each format without correction factor (correction factor = 1).
TV-Iris Actual Position	Shows the actual TV iris value.
TV-Iris Nominal Value	Shows the stored or nominal TV iris value from the learning phase.
Gain Factor	Shows the gain factor (Camera) During dose adjustment the gain factor = 2

Prerequisites

The proposed prefilter without a grid for full format/zoom 1/zoom 2 is **2.1 mm Cu**.

The proposed prefilter with a grid for full format/zoom 1/zoom 2 is **1.8 mm Cu**.

The proposed prefilter without a grid for zoom 3 is **1.8mm Cu**.

The proposed prefilter with a grid for zoom 3 is **1.5 mm Cu**.

NOTE

If the correct adjustment of the dose rate cannot be achieved, increase or reduce the CU filter in increments of 0.3 Cu.

Dose rate correction factors

The correction factor for the small dose measurement chamber is 1.00.

The correction factor for the large dose measurement chamber is 1.06.

Grid correction factor is 1.50.

➪ Preferably remove the grid from the I.I.

The correction factor in the case of a large chamber and grid is 1.59.

Dose rate 33 cm I.I.

Format (Cu filter)	**Correction factor**	**Dose rate in nGy/s 33cm (13 “) I.I.**	
		Lower	**Upper**
Full format (2.1 mm Cu with grid) (1.8 Cu mm without grid)	**1.00** - without grid	**131**	**1047**
	1.06 - without grid + large chamber	139	1109
	1.50 - grid + small chamber	197	1571
	1.59 - grid + large chamber	208	1665
Zoom 1 (2.1 mm Cu with grid) (1.8 mm Cu without grid)	**1.00** - without grid	**185**	**1480**
	1.06 - without grid + large chamber	196	1567
	1.50 - grid + small chamber	278	2220
	1.59 - grid + large chamber	294	2353
Zoom 2 (2.1 mm Cu with grid) (1.8 mm Cu without grid)	**1.00** - without grid	**523**	**2093**
	1.06 - without grid + large chamber	554	2219
	1.50 - grid + small chamber	785	3140
	1.59 - grid + large chamber	832	3328
Zoom 3 (1.8 mm Cu with grid) (1.5 mm Cu without grid)	**1.00** - without grid	**740**	**2960**
	1.06 - without grid + large chamber	784	3137
	1.50 - grid + small chamber	1110	4440
	1.59 - grid + large chamber	1176	4706

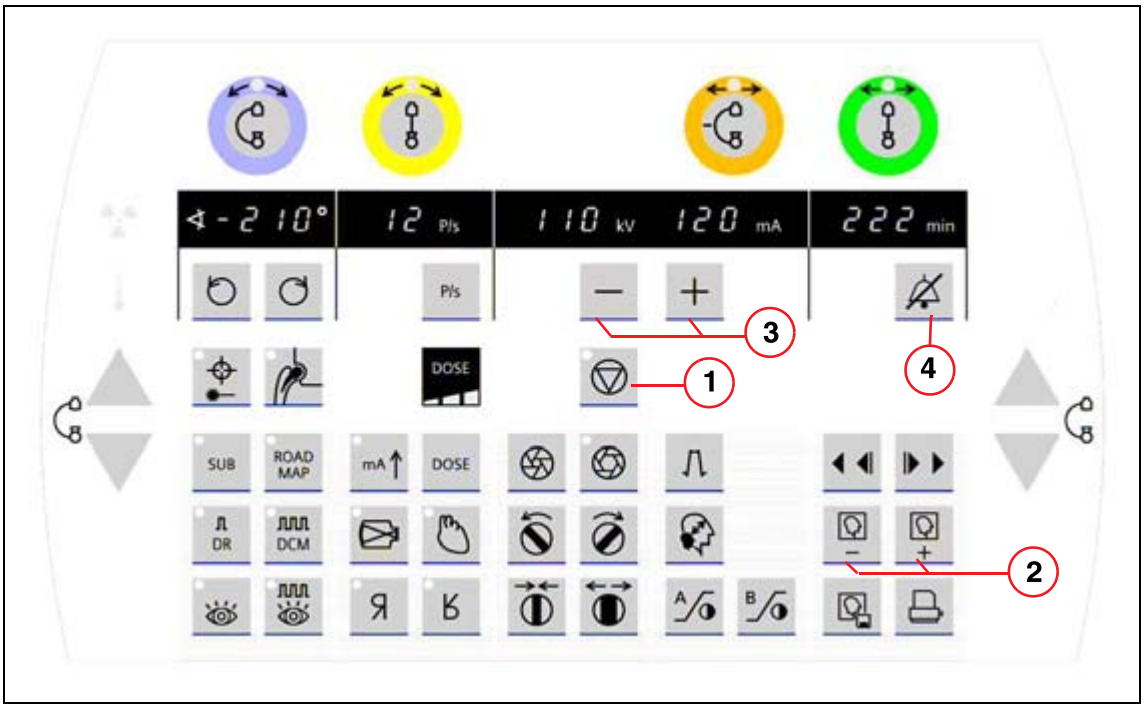

Fig. 10: Control board

Adjustment

1. Register an emergency patient to allow radiation release.
2. Open the service application.
   - ➪ The open service application makes the dominant circle visible.
3. Attach the dose measurement chamber on the I.I. input screen.
   - ➪ If a small chamber is used: Attach chamber in full format and zoom format outside the displayed dominant circle but inside the visible field.
   - ➪ If a large chamber is used: Center the chamber to the displayed in the dominant circle.
4. Place **2.1 mm Cu** in front of the collimator (used for full format, zoom 1 and zoom 2).
5. Click on **<Go>** to start the dose rate adjustment and wait until "**START fluoroscopy**" appears in the status bar "Auto Regulation".
   - ➪ X-iris and the slot diaphragm open automatically to the max. outside position.
   - ➪ The DA CFC 75 kV curve is displayed in the status bar "Control Curve".
   - ➪ I.I. full format is automatically selected and displayed in the status bar "I.I. Zoom Status".
6. **Start fluoro**, wait 5 seconds then press the **"KV STOP"** key (see Stop key (1/Fig. 10 / p. 32)) on the control console.
   - ➪ Continue fluoro.

7. **Adjust dose rate** by using the “mA” and “page” control console keys (2/3/Fig. 10 / p. 32).
   - ➪ The target of the dose rate value without the correction factor is displayed in the "Dose Rate" status bar.
   - ➪ Tolerance for the dose rate: **± 5%**
   - ➪ Use keys [+page] and [-page] (2/Fig. 10 / p. 32) for 1/2 exposure points.
   - ➪ Use keys [+ mA] and [- mA] (3/Fig. 10 / p. 32) for 1/16 exposure points.
   - ➪ After adjustment, wait until “**MATCH Doserate**” appears in the “Auto Regulation” status bar.
   - ➪ Continue fluoro.
8. Press the “**alarm key**” (see alarm key (4/Fig. 10 / p. 32)) on the control console.
   - ➪ The message “**autoadjust TV Iris**” appears in the “Auto Regulation” status bar.
   - ➪ The message “**STOP fluoroscopy** appears in the “Auto Regulation” status bar.
9. **Stop fluoro** and wait until “**START fluoroscopy**” appears in the “Auto Regulation” status bar.
   - ➪ Carry out the same procedure for the full format upper dose rate as well as for the remaining zoom formats.
   - ➪ The selection of the remaining zoom formats and the lower/upper dose rates is performed automatically by software.
   - ➪ Before adjusting the dose for the **Zoom 3** format, reduce the Cu filter in use by 0.3 mm.
   - ➪ After completion, “**Done**” appears in the "Auto Regulation” status bar.
10. After completing the adjustment, click on <**Save**>.
    - ➪ A window appears: “Main system values were successfully saved” --> confirm with <**OK**>.
11. Click on “**>**” for the next 8 pages and click on <**Finish**>.

Checking the Dose Rate in Automatic Mode

Exam set selection	I.I. format	Mode	Dose level	Control characteristic	Dose rate in nGy/s at the I.I. input without correction factor (min. ... max.)	Tolerances in %
Ortho/Trauma Body reg: Leg Standard	Full format	CFC	MID	**S2**	131 (112 ... 150)	± 15 %
Ortho/Trauma Body reg: Hip Standard	Full format	CFC	MID	HC2	131 (112 ...150)	± 15 %

Exam set selection	I.I. format	Mode	Dose level	Control characteristic	Dose rate in nGy/s at the I.I. input without correction factor (min. ... max.)	Tolerances in %
Ortho/Trauma Body reg: Hip Standard	Full format	PFL 7.5 f/s	MID	HC2	66 (56 ... 76)	± 15 %
Ortho/Trauma Body reg: Hip Standard	Full format	DCM 7.5 f/s	HIGH	HC2	459 (390 ... 527)	± 20 %
Ortho/Trauma Body reg: Hip Standard	Full format	Roadmap	HIGH	IOD	524 (446 ... 602)	± 15 %
Ortho/Trauma Body reg: Hip Standard	Zoom 1	CFC	MID	HC2	185 (139 ... 231)	± 25 %
Ortho/Trauma Body reg: Hip Standard	Zoom 2	CFC	MID	HC2	260 (195 ... 325)	± 25 %
Ortho/Trauma Body reg: Hip Standard	Zoom 3	CFC	MID	HC2	367 (275 ... 550)	+ 50% - 25%

NOTE

If required, look for the correction factors under “Dose Rate correction factors”.

In zoom 3 format, the I.I. input size is smaller than the large measurement chamber. This causes the measured values to be about 15% less than expected.

1. Remove the grid from the I.I. (reinstall after measurement).
2. Open the service application.
   ➪ The open service application makes the dominant circle visible.
3. Adjust the X-iris and the slot diaphragm to the outside position.
4. Select the corresponding exam set.
   ➪ Control characteristic curve “**HC2**” and “**IOD**” is active with selection of the exam set “Ortho/Trauma”, “Hip” and “Standard”.
   ➪ Control characteristic curve “**S2**” is active with selection of the exam set “Ortho/Trauma”, “Leg” and “Standard”.
   ➪ Select in each case the corresponding “Mode”, “I. I. format” and “Dose level”.

5. Briefly release fluoro and choose in each case the Cu prefilter so that **75 kV ± 5 kV** is displayed on the control console.

   ➪ Continue with the description **6a or 6b** depending on the used dose measurement chamber size.

6a. Procedure with **small measurement chamber:**

- Measurement for **all formats** and **all modes**:

  ➪ Attach the small chamber for each format outside the dominant circle but inside the visible x-ray field on the I.I.

  ➪ Carry out the measurement.

6b. Procedure with **large measurement chamber:**

- Measurement for **full format** and mode "**CFC**"; "**PFL**" and "**DCM**":

  ➪ Release X-ray in each mode ("CFC"; "PFL", "DCM") and press the automatic stop key.

  ➪ Attach in each case the large chamber in the center of the dominant circle displayed on the I.I.

  ➪ Carry out the measurement.

  ➪ Release the automatic stop key after each measurement.

- Measurement for **full format** and mode "**Roadmap**":

  ➪ Select "Roadmap" and fluoro for about 4 seconds and stop fluoro --> automatic stop is automatically selected.

  ➪ Attach the large chamber in the center of the displayed dominant circle on the I.I.

  ➪ Carry out the measurement.

  ➪ Release the automatic stop key after the measurement.

- Measurement for **zoom 1 / 2 / 3** and **mode CFC**:

  ➪ Attach the large chamber in the center of the displayed dominant circle on the I.I.

  ➪ Carry out the measurement.

  ➪ When working specifically in zoom 3 format with the large chamber (112 cm^3), the tolerance range has to be changed from -25% / +50% to -40% / +35%.

Chapter 2 Accuracy of the Dose Area Product: Tolerance changed from 30 % to 25 %.